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RAM Intro

A. Sicherman

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Disclaimer

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RAM Intro

Presention to Dr. Hans Mark
Director, Defense Research and Engineering
U.S. Department of Defense

Alan Sicherman
Lawrence Livermore National Laboratory

Livermore, California
October 5, 2000

The NIF RAM program comprises three major activities

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- **Top-down allocation Modeling**
  Budgeting of system availability and reliability goals to lower subsystems.

- **Bottom-up Achievability Assessment**
  Failure Modes and Effects analysis and subsystem performance estimates using component data.

- **Operations Modeling**
  Simulation of stochastic systems functioning under specified operating scenarios and policies.

The analyses and models iterate as the design progresses

RAM Achievability Modeling and Tracking

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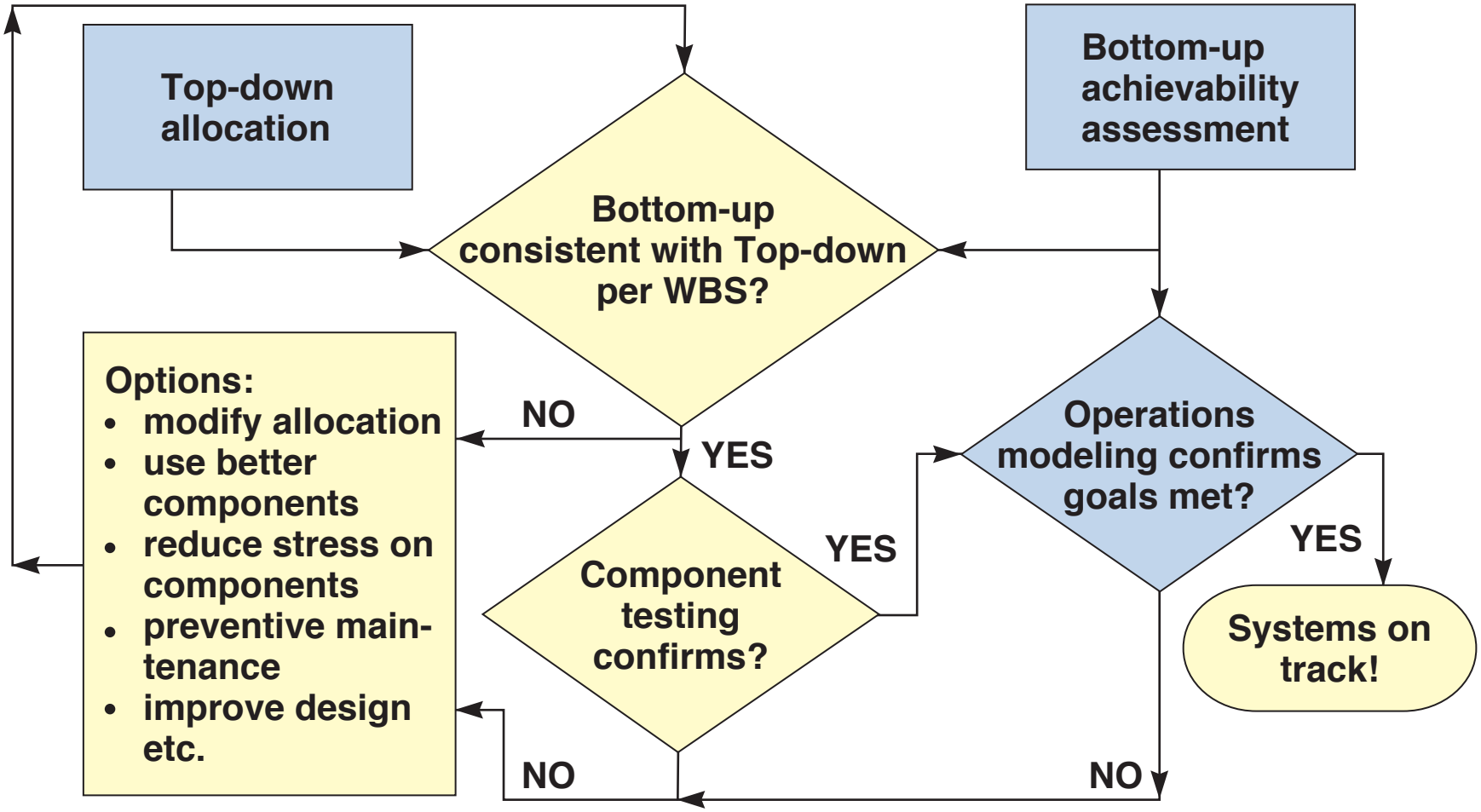

Goals and Assumptions

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- System goals as stated in 1994 CDR
  - Operation days: 365 – 12 vacation days – 69 scheduled maintenance days = 284
  - 90% availability with respect to random failure (unplanned maintenance = 28 days/year)
  - 80% shot reliability (acceptable energy, etc.)

- Goal assumptions
  - Steady state conditions with no "yield" shots (after start-up and debug)
  - 3 shots/day (3 * 256 or about 770 shots/year
  - On average, 616 successful shots/year
  - Target itself not included

Allocation, FMEA and Operability Model Analyses complement and cross-check each other

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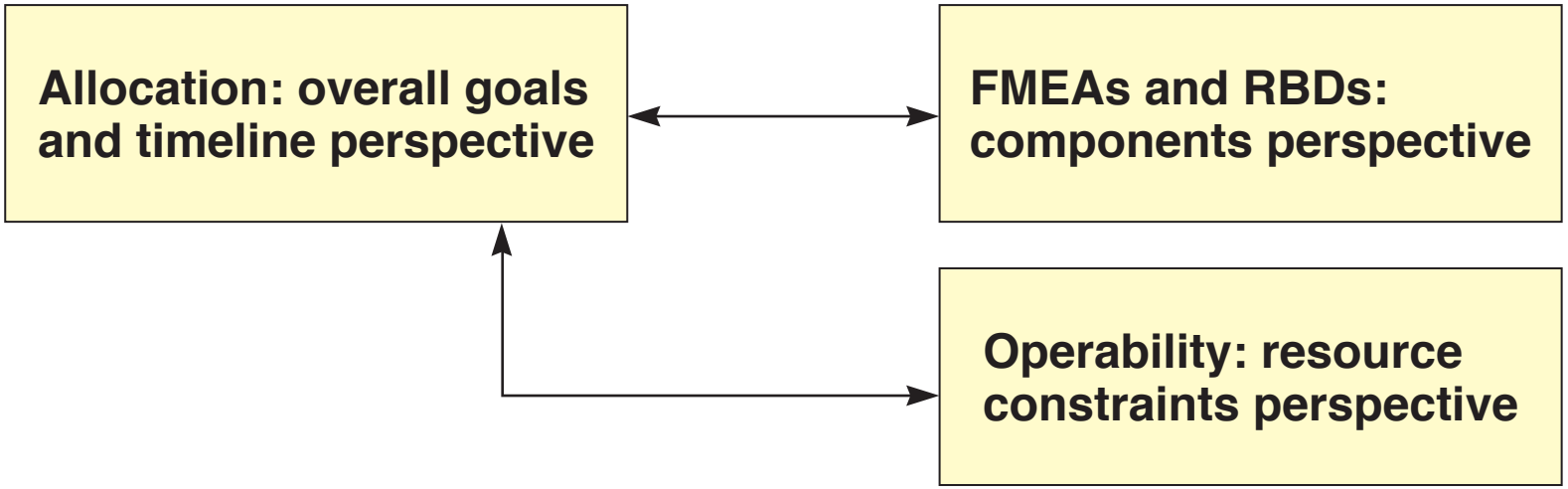

Allocation provides:

- Benchmarks to cross-check FMEA analyses and operability model algorithms
- Discipline on degree of conservatism used in operability and FMEA analyses
- Goals so designers have some idea if RAM performance is reasonable, or if design changes should be explored, or whether certain cost trade-offs are advisable

Shot Timeline

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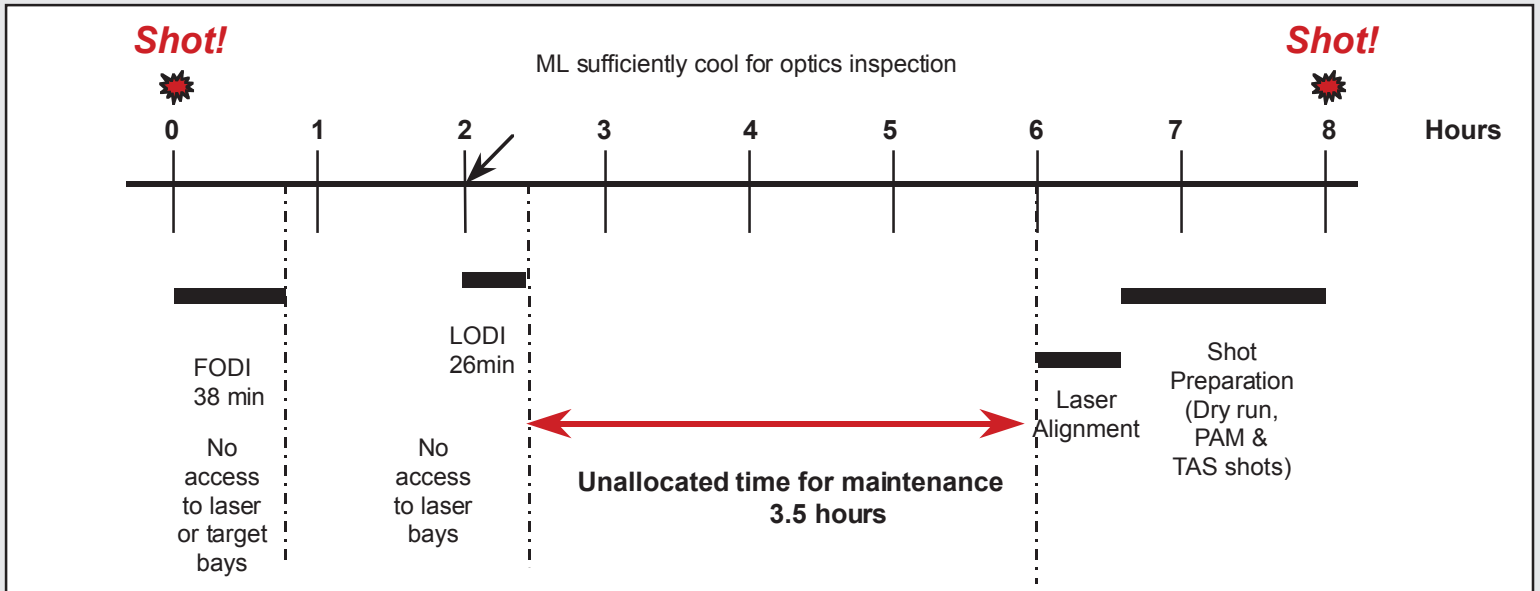
Working NIF Shot Preparation Timeline



FODI = Final Optics Damage Inspection
LODI = Laser Optics Damage Inspection
TAS = Target Alignment Sensor
PAM = Preamplifier Module
ML = Main Laser

Baseline - 8 hours between shots

NIFSim Operations model confirms baseline annual shot rate

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- Baseline timeline
  - 8 hours between shots
  - Maintenance done between shots if less than 4 hours
  - No limitations on personnel, equipment or spares resources
  - Three shifts per day, 284 operating days/year
  - One maintenance day per week
- Number of shots per year predicted to be: 770

NIFSim Model Assumptions

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- Model is based on calculations of mean time between failures (MTBF) and mean time to replace (MTTR)
  - Based on mid-title II RAM assessments
  - Only as accurate as the input information
  - Engineering estimates for personnel required for maintenance
- LRU refurbishment rates (OAB throughout) are modeled in a separate model and the links to the NIFSim model are underway but incomplete to date
- Failures are modeled as random, no systematic failures modeled

History of NIF RAM analysis

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93	94	95	96	97	98	99	00	01	02

Conc. Des

Adv. Conc. Design

Title I

Title II, Detailed Design

Revalidate Rqm'ts, ICDs

△ Introduction of NWBS

Recast/review WBS RAM analysis

Early flashlamp RAM studies

Allocations (Top down)

Fine tuning

Finer tuning

- Incorporate latest RAM analysis
- Incorporate NOVA/NIF Prototype data
- Incorporate latest preventative maintenance plans

- Collaboration between RAM/LRU designers
- Iterative trade-off studies

FMEA (Bottom up)

△ Title I

△ 65% Title II

△ Title II

- Designs improving
- Maintenance strategies solidifying
- Incorporation of higher quality components

NIF Sim Simulated Operations Planning

△ Title I

△ 65% Title II

△ Title II

- Improved shot timeline info
- Updates from FMEAS
- Updates on personnel budgets
- Updates on equip. inventories
- Improved model capabilities

RAM assumptions and strategy for WBS 1.6: Optical components

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- Reliability is high
  - Gradual growth of damage and inspections on every shot ensure that optics are replaced before they may cause a shot failure
  - Damage generated during a shot does not normally ruin the shot, although there may be exceptions (polarizer coating, debris shields e.g.)
- Availability is high
  - Gradual growth of damage and inspections on every shot allow to defer replacement to a scheduled maintenance day
    - this does not apply for vacuum barriers (spatial filter lenses and vacuum windows), and actuator failure of the LM1 deformable mirror
  - Many LRU's can be replaced within the allocated maintenance window in between shots
- LRU replacement is the dominant activity during a scheduled maintenance
  - The refurbishment capacity and personnel assumptions have been validated using the NIFSim operability model - revalidation in progress using a commercial ProModel code
  - Optics replacement costs are part of the NIF Operations cost model

Availability allocation goals and data sources

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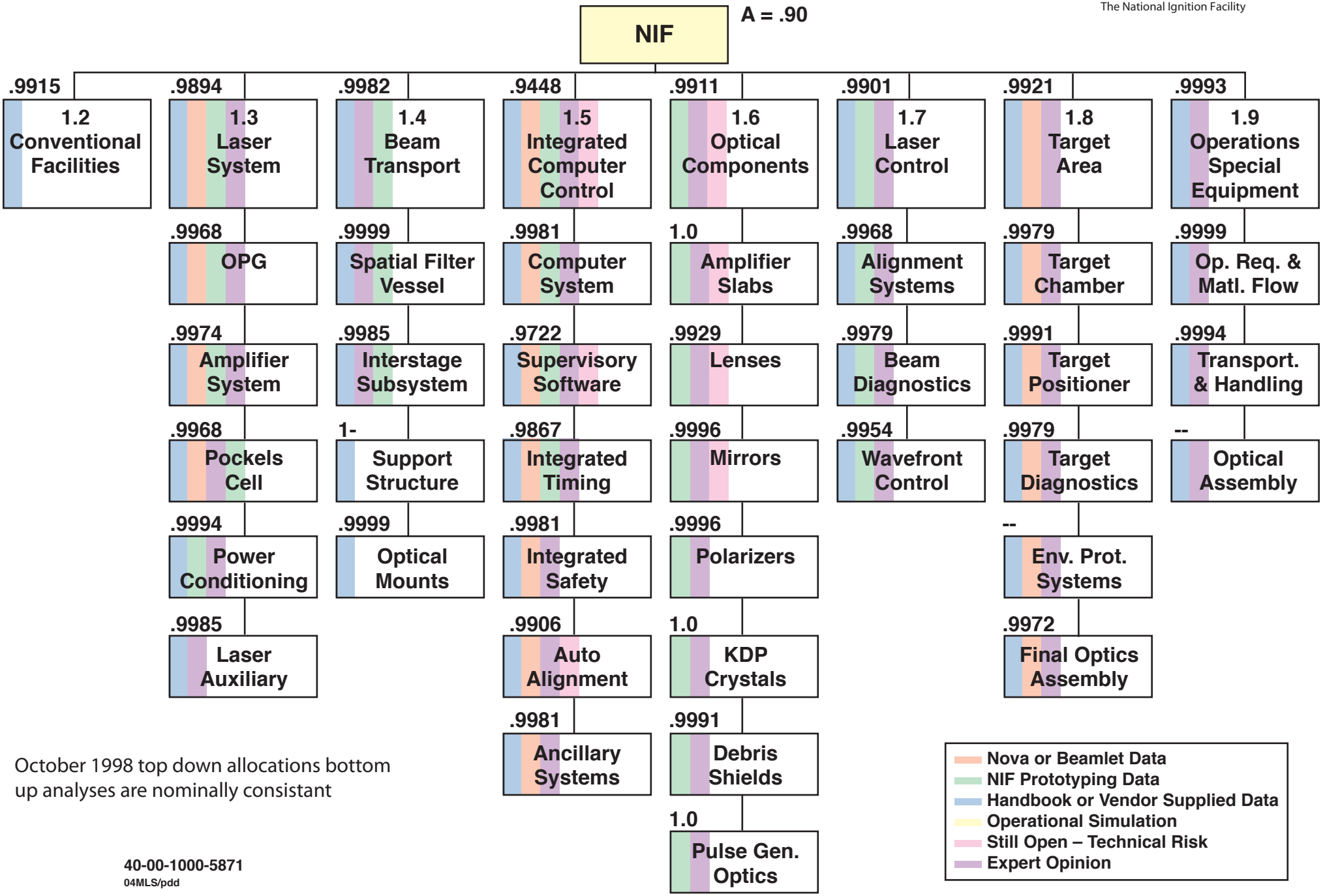

October 1998 top down allocations bottom up analyses are nominally consistant

Nova or Beamlet Data
NIF Prototyping Data
Handbook or Vendor Supplied Data
Operational Simulation
Still Open – Technical Risk
Expert Opinion

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Reliability allocation goals and data sources

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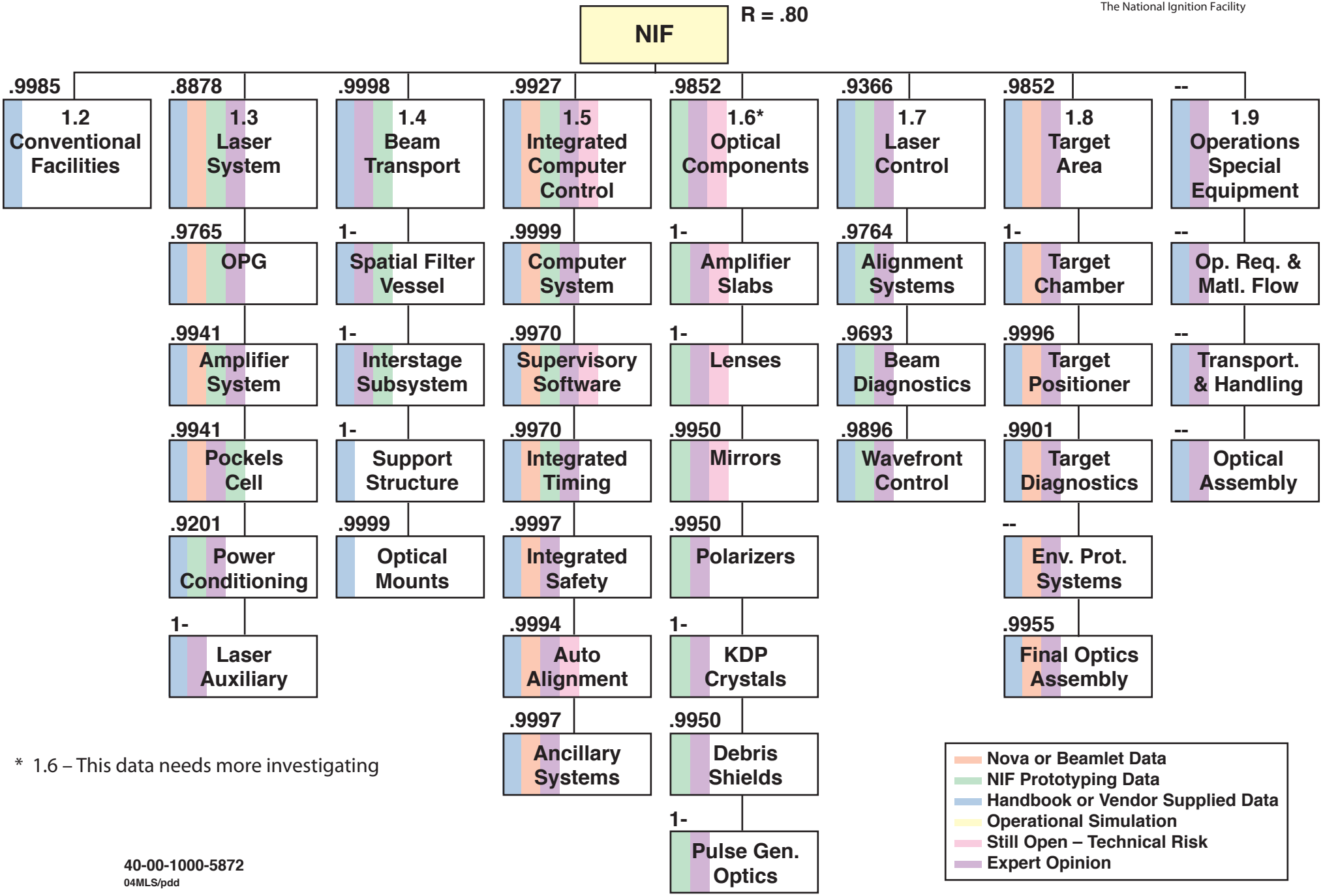

* 1.6 – This data needs more investigating

- Nova or Beamlet Data
- NIF Prototyping Data
- Handbook or Vendor Supplied Data
- Operational Simulation
- Still Open – Technical Risk
- Expert Opinion

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